

Remarks.

This paper is filed in response to the office action within one month after the shortened statutory period set forth in the office action dated April 2, 2003. A Request for Extension of Time and fee is filed with this response.

Please enter the following amendments and remarks into the prosecution history of the subject application without prejudice or disclaimer.

In the claims.

Please replace currently pending claims 1, 9 and 16 with amended claims 1, 9 and 16. No additional claims have been added nor have any claims been canceled with this response. The claims that are pending prior to the entry of the amendments in this response are called currently pending claims. Upon amendment, the above-identified US patent application will have 3 independent claims (amended claims 1, 9 and 16) and 22 total claims (currently pending claims 2-8, 10-15 and 17-20 and amended claims 1, 9 and 16). Applicants have previously paid for up to 22 claims and 3 independent claims. Therefore, no fee for excess claims is required with this response.

Claim rejections under 35 U.S.C. §102.

The Examiner rejects claims 1-4, 6, 7, 9 10, 12, 14-17, 19, 21 and 22 under 35 U.S.C. §102(e) as being anticipated by US Patent Application No. 2002.0045353A1 hereinafter called Kang. Independent claims 1, 9 and 16 have been amended to recite an etching gas consisting of  $C_5F_8$  and  $CHF_3$  in claim 1, consisting of  $C_4F_6$  and  $CHF_3$  in claim 9 and consisting of  $C_nF_{2n-2}$  and  $CHF_3$  in claim 16. Independent claims 1, 9 and 16 are not anticipated by Kang because Kang discloses an etching gas containing a linear octafluorobutene which further comprises a first gas having the formula  $C_xF_y$  wherein  $x=1-5$  and  $y= 2-12$ , and a second gas having the formula  $C_xH_yF_z$  wherein  $x=1-5$ ,  $y= 1-4$  and  $z= 2-10$ . However, the independent claims 1, 9 and 16 recite an etching gas

consisting of  $C_5F_8$  and  $CHF_3$ ,  $C_4F_6$  and  $CHF_3$  and  $C_nF_{2n-2}$  ( $n=4$  or  $5$ ) and  $CHF_3$ . Since the independent claims 1, 9 and 16 are not anticipated by Kang, the dependent claims 2-8, 10-15 and 17-22 are not anticipated by Kang as well.

Claims rejections under 35 U.S.C. §103.

The Examiner rejects claims 1-7 and 9-22 under 35 U.S.C. §103(a) as being unpatentable over Kang in view of US Patent No. 6,316,349 hereinafter called Kim et al. and further in view of US Patent No. 6,335,249 hereinafter called Thei et al.

Kang has already been discussed in the preceding section in regards to the rejection under 35 U.S.C. §102(e). Kang teaches a method involving etching a silicone oxide containing layer by using plasma from an etching gas containing a linear octafluorobutene. See claim 1 of Kang.

The amended claim 1 has the following limitations:

A method of forming a self-aligned contact hole suitable for a semiconductor substrate having a pair of gate electrodes, comprising the steps of:  
forming a nitride etching stop layer over the gate electrode and the semiconductor substrate;  
forming an oxide insulating layer on the nitride etching stop layer; and  
plasma-etching the oxide insulating layer by an etching gas consisting of  $C_5F_8$  and  $CHF_3$  so as to form a self-aligned contact hole between the pair of gate electrode, thereby equalizing the etching rate to the etching stop layer at the top corner and the bottom of the contact hole.

The independent claims 9 and 16 have the same limitations except that the etching gases of claim 9 and 16 consist of  $C_4F_6$  and  $CHF_3$  and  $C_nF_{2n-2}$  ( $n=4$  or  $5$ ) and  $CHF_3$ , respectively. Kang teaches an etching gas which contains octafluorobutene. As explained, the independent claims 1, 9 and 16 recite an etching gas which consists of the

mentioned gases and do not recite octafluorobutene. There is no teaching or suggestion in Kang not to use octafluorobutene. To the contrary, Kang teaches that it is absolutely necessary to use octafluorobutene. Note claims 1-3 of Kang, for example. Clearly the  $C_xF_y$  and  $C_xH_yF_z$  gases are added to octafluorobutene. There is absolutely no suggestion of an etching gas consisting of the mixture recited in the claims of this application. If the Applicants invent a new etching gas according to claims 1, 9 and 16 which does not contain octafluorobutene and obtain excellent etching results, then those claims 1, 9 and 16 are clearly not obvious in view of Kang. Kang teaches away from the claims 1, 9 and 16.

The Examiner rejects claims 2, 10 and 17 because they recite BPSG which is disclosed in paragraph 26 of Kang. The Examiner further rejects claims 4, 12 and 19 because they recite treating etching stop layer silicone nitride which is disclosed in paragraph 33 of Kang. The Examiner further rejects claims 6, 14 and 21 because they recite that the etching gas further comprises an inert gas which is disclosed in paragraph 31 of Kang. Finally, the Examiner rejects claim 7, 15 and 22 which recite that the inert gas is argon and which is disclosed in paragraph 31 of Kang. The rejections of dependent claims 2, 4, 6, 7, 10, 12, 14, 15, 17, 19, 21 and 22 in view of Kang are improper because independent claims 1, 9 and 16 are not obvious in view of Kang as explained above.

The Examiner rejects independent claims 1, 9 and 16 in view of Kang and further in view of Kim et al. The Examiner asserts that it would be obvious to the person of ordinary skill in the art to form an oxide insulating layer by using a reactive gas as taught by Kim et al. in the process of Kang. Applicants respectfully traverse the Examiner's assertion. Applicants explained above that Kang teaches away from independent claims 1, 9 and 16 of the present application because the etching gas of Kang contains octafluorobutene. The Examiner asserts that Kim et al. use an etching gas containing  $C_4F_6$  and  $CHF_3$  or  $C_5F_8$  and  $CHF_3$ . What does the Examiner base this assertion on? Kim et al. mention in column 9, lines 15-21 a CHF-based gas selected from the group consisting of  $C_2F_4$ ,  $C_2F_6$ ,  $C_3F_6$ ,  $C_3F_8$ ,  $C_4F_8$ ,  $C_4F_6$ ,  $C_4F_{10}$ ,  $CHF_3$ ,  $C_2HF_5$ ,  $C_2H_2$ ,  $CH_2F_2$ ,  $C_xH_yF_z$  ( $x+y=2, 3, 4, 5$ ,  $z=4, 6, 8, 10$ ) and mixtures thereof. Kim et al. do not teach

CHF<sub>3</sub> as an etching gas. Therefore, Kim et al. do not teach or suggest an etching gas containing C<sub>4</sub>F<sub>6</sub> and CHF<sub>3</sub> or C<sub>5</sub>F<sub>8</sub> and CHF<sub>3</sub> or CnF<sub>2n-2</sub> and CHF<sub>3</sub> wherein n=4 or 5 according to independent claims 1, 9 and 16.

If the Examiner disagrees, then the Examiner is respectfully requested to point out with particularity exactly how the independent claims are either anticipated or rendered obvious by the prior art. Please see 37 CFR 1.104(c)(2). The Examiner is respectfully requested to point out the particular part of the prior art document that the Examiner asserts teaches the element of the rejected claims as required by this rule.

Kim et al. teach away from the present invention. Since Kim et al. leave out CHF<sub>3</sub>, the implication for a person skilled in the art is that CHF<sub>3</sub> and CHF<sub>3</sub> combined with C<sub>5</sub>F<sub>8</sub> or with C<sub>4</sub>F<sub>6</sub> does not work. If Applicants use CHF<sub>3</sub> despite the teaching of Kim et al., then independent claims 1, 9 and 16 are certainly not obvious in view of Kim et al.

Prima facia case of obviousness.

The Examiner is respectfully reminded that in order to establish a prima facia case of obviousness, three criteria must be met according to Manual of Patent Examining Procedure (MPEP) 2142.

- First, there must be some suggestion or motivation either in the references themselves or in the knowledge generally available to one of ordinary skill in the art to modify the reference or to combine reference teachings.
- Second, there must a reasonable expectation of success if the references are combined.
- Finally, the prior art reference or combined with other references must teach or suggest all the claim limitations.

Kang and Kim et al. do not teach or suggest all the claim limitations of independent claims 1, 9 and 16. Further, there is no suggestion or motivation in Kang to modify Kang or to combine the teaching of Kang with the teaching of Kim et al. Both references Kang and Kim et al. teach away from each other as explained above because

Kang teaches to use octafluorobutene and Kim et al. does not teach or suggest using  $\text{CHF}_3$ . There is no reasonable expectation of success to modify Kang or combine with Kim et al. because the person skilled in the art would be motivated to combine octafluorobutene with other gases and to try reaching better etching results.

The Examiner rejects claims 3, 11 and 18 because they recite that the reactive gas contains TEOS in view of Kang and Kim et al. The Examiner acknowledges that Kang does not teach or suggest a reactive gas containing TEOS. Independent claim 1, 9 and 16 are not obvious in view of Kang and Kim et al., therefore dependent claims 3, 11 and 18 are not obvious in view of Kang and Kim et al. as well.

The Examiner rejects claims 5, 13, and 20 because they recite that the nitride etching stop layer is silicon oxy-nitride. The Examiner acknowledges that Kang fails to teach that the nitride etching stop layer can be a silicon oxy-nitride. The Examiner asserts that Thei et al. teach that an etch stop barrier layer can be a silicon oxy-nitride. The Examiner asserts that it would have been obvious to a person of ordinary skill in the art to form an etch stop oxy-nitride layer in the process of Kang as taught by Thei et al. Applicants respectfully traverse the Examiner's assertion. Kang does not teach or suggest forming an etch stop oxy-nitride layer. Thei et al. teach to use an etchant gas such as  $\text{CF}_4$  and  $\text{H}_2$  or  $\text{CHF}_3$  which etches  $\text{SiO}_2$  layer. See column 5, lines 60 to 63. Thei et al. further teach a method for fabricating salicide field effect transistors. The process according to Thei et al. includes forming source/drain contact areas, depositing a conformal etch stop layer, depositing an interlevel dielectric layer and etching said interlevel dielectric layer to said source/drain areas. See claim 1. The etch stop layer may be silicon nitride or silicon oxy-nitride. See column 2, lines 17 to 20.

Thei et al. teach away from independent claims 1, 9 and 16 because Thei et al. teach to etch the dielectric layer to said source/drain areas. Thei et al. teach away from Kang as well. Kang teaches etching a silicon oxide containing layer using plasma with high oxygen to nitride selectivity. Kang teaches to etch the silicon oxide containing layer but teaches to avoid to etch the silicon nitride layer. Since Thei et al. do not teach or suggest

the need of oxygen to nitride selectivity, a person skilled in the art would not be motivated to modify the teaching of Kang by combining it with the teaching of Thei et al. The Applicants submit that Kang and Thei et al. do not teach or suggest all the claim limitations of claims 1 and 5, 9 and 13, and 16 and 20 and there is no motivation or reasonable expectation of success in modifying the teaching of Kang by combining it with the teaching of Thei et al.

The Examiner rejects claim 8 under 35 U.S.C. 103(a) as being unpatentable over Kang in view of US Patent No. 6,335, 249 hereinafter called Thei et al. and further in view of US Patent No. 6,337,244 hereinafter called Prall et al. The Examiner asserts that Kang teaches a method for forming a self-aligned contact hole by etching the silicon oxide layer using  $C_5F_8/CHF_3/Ar$  but fails to teach the specific  $C_5F_8/CHF_3$  mixture ratio of the etching gas that is between 0.4 to 0.75. The Examiner further asserts that Prall et al. teach  $C_5F_8/CHF_3$  a gas ratio of between 0.2 to 5. The Examiner's assertion in regard to Kang is wrong as explained above. Kang teaches the use of octafluorobutene and additionally a first and second fluorinated gas. As explained above, Kang teaches away from the claim limitations of independent claims 1, 9 and 16.

Prall et al. teach a first line of floating gates over a crystalline silicon substrate providing an alternative series of  $SiO_2$ , forming a masking layer over the floating gates, forming a third line mask opening in the masking layer over at least a portion of the second line, and substantially anisotropically etching the  $SiO_2$  using a gas comprising a combination of at least one non-hydrogen containing fluorocarbon having at least three carbon atoms and at least one hydrogen containing fluorocarbon. See claim 1. Prall et al. do not teach plasma etching of an oxide insulating layer which is formed on the nitride etching stop layer according to the independent claims 1, 9 and 16. Claim 8, which is dependent from claim 1 recites a ratio of between 0.4 and 0.75.

Kang and Prall et al. do not teach or suggest all the claim limitations of claim 1 and 8. There is no suggestion or motivation to combine the teaching of Kang and Prall et al. in order to obtain the claim limitations of claims 1 and 8. There would be no expectation of

success to combine Kang and Prall et al. Why should a person skilled in the art combine Kang, which teaches an etching gas containing octafluorobutene and optionally comprising a first and second fluorinated gas with Prall et al. which does not teach or suggest etching an oxide insulating layer which is formed on the nitride etching stop layer? Kang teaches an etching gas with a selectivity between silicon oxide and silicon nitride. A person skilled in the art would try to improve the etching properties of the gas by etching oxide formed on a nitride layer by knowing Kang, combining octafluorobutene with other fluorinated gases. The person skilled in the art would have no reason to modify Kang by a teaching which does not include an oxide insulating layer on the nitride etching stop layer as taught by Prall et al. Kang and Prall et al. clearly teach away from each other.

As stated above, the three criteria to establish a prima facie case of obviousness are not met by combining the teachings of Kang with Kim et al. or Kang with Prall et al. Clearly, the Examiner has combined these references based on a hindsight reconstruction of the Applicants' claims. Therefore, the motivation or suggestion to combine the references is based on the Applicants' own disclosure. Hence, the Applicants submit that the rejection of amended claims 1, 9 and 16 and the dependent claims 2-8, 10-15 and 17-22 as being unpatentable over Kang and Kim et al. or Kang and Prall et al. is improper. Applicants respectfully request that the rejection of claims 1-22 on grounds be withdrawn.

If the Examiner maintains the rejection of amended claims 1, 9 and 16 on grounds, the Applicants respectfully request that the Examiner show how the references teach or suggest every element of the rejected claims and where the motivation for making the suggested combination can be found in the cited references. It is believed that independent claims 1, 9 and 16 are allowable and therefore dependent claims 2-8, 10-15 and 17-22 are allowable as well.

Accordingly, reconsideration and examination of the present application is respectfully requested.

The application is now in condition for allowance. Allowance of the application at an early date is respectfully requested.

The Commissioner is authorized to charge any additional fees which may be required or credit overpayment to deposit account no. 12-0415. In particular, if this response is not timely filed, then the Commissioner is authorized to treat this response as including a petition to extend the time period pursuant to 37 CFR 1.136 (a) requesting an extension of time of the number of months necessary to make this response timely filed and the petition fee due in connection therewith may be charged to deposit account no. 12-0415.

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August 1, 2003

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(Date of Deposit)

Corinda Humphrey

\_\_\_\_\_  
(Name of Person Signing)

*Corinda Humphrey*  
\_\_\_\_\_  
(Signature)

August 1, 2003

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(Date)

Respectfully submitted,



\_\_\_\_\_  
Richard P. Berg  
Attorney for Applicants  
Reg. No.28,145  
LADAS & PARRY  
5670 Wilshire Boulevard, Suite 2100  
Los Angeles, California 90036  
(323) 934-2300